REMARKS

This application is based on an international application PCT/FI2004/000139, filed March 11, 2004, which designates the United States.

The international application was published as WO2004/081591, a copy of which is attached. The WO document was published as filed with claims 1-7. No amendments were filed in the international application.

A National Phase application was filed pursuant to 35 U.S.C. 371 on October 21, 2004. The National Phase case indicates that the international application was communicated to the United States Patent and Trademark Office by the International Bureau as filed.

The National Phase case was filed with the same claims 1-7. In addition, a preliminary amendment was filed adding claims 8-12, a copy of which is attached.

The National Phase transmittal also included a courtesy copy of the International application which included the original claims 1-7 and claims 8-12 designated (New).

It is believed that the Notice of Non-Compliant Amendment incorrectly states that there were 12 original claims. In fact, there were 7 original claims and 5 additional or new claims.

It is requested therefore that the Notice be withdrawn and that this application be forwarded for examination.

The Director is hereby authorized to charge any fees required, including the fee for any extensions of time, to Deposit Account No. 04-2223.

Respectfully submitted,

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

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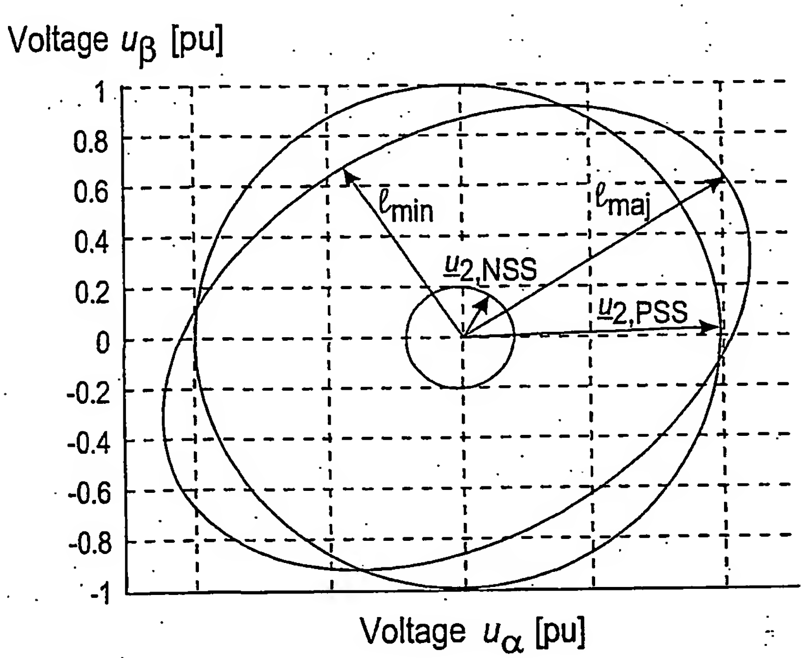
Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ,*

[Continued on next page]

(54) Title: METHOD FOR DETERMINING A NEGATIVE SEQUENCE COMPONENT



(57) Abstract: The invention relates to a method for determining properties of a negative sequence component of a space vector quantity in an electrical network. The method according to the invention comprises the steps of determining on the basis of the properties of an ellipse formed by a space vector of the space vector quantity in the electrical network the magnitude of the negative sequence component of the space vector quantity in the electrical network and the location of the negative sequence component of the space vector quantity in the electrical network in relation to a positive sequence component.

WO 2004/081591 A1

TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)

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— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

METHOD FOR DETERMINING A NEGATIVE SEQUENCE COMPONENT

BACKGROUND OF THE INVENTION

[0001] The invention relates to determining properties of a negative sequence component of a space vector quantity in an electrical network.

[0002] A three-phase unbalanced network can be presented with the aid of three symmetrical three-phase components, i.e. the zero sequence system (ZSS), the positive sequence system (PSS) and the negative sequence system (NSS).

[0003] The negative sequence system is defined by means of negative sequence components of quantities in an electrical network. Negative sequence components of quantities can be utilized in monitoring and controlling the electrical network.

BRIEF DESCRIPTION OF THE INVENTION

[0004] An object of the invention is to provide a method for determining properties of a negative sequence component of a space vector quantity in an electrical network. This object is achieved with a method that is characterized by what is stated in the independent claim. Preferred embodiments of the invention are described in the dependent claims.

[0005] The method according to the invention for determining properties of a negative sequence component of a space vector quantity in an electrical network can be utilized with compensation methods of voltage unbalance in an electrical network, for example.

[0006] The invention is based on determining the properties of the negative sequence component of a space vector quantity in an electrical network on the basis of the properties of an ellipse formed by a space vector of the space vector quantity in the electrical network.

BRIEF DESCRIPTION OF THE FIGURES

[0007] The invention will now be described in greater detail in connection with preferred embodiments, with reference to the attached drawings, of which:

Figure 1 shows circular graphs drawn by the tips of space vectors of the positive sequence and negative sequence systems, and an elliptical graphs drawn by the tip of a sum vector;

Figure 2 shows a block diagram for determining the components of the semi-axes of an ellipse formed by a voltage space vector in an electrical network; and

Figure 3 shows a block diagram for determining the magnitude of the negative sequence component of the voltage in an electrical network and the angle of the minor semi-axis of the voltage ellipse.

DETAILED DESCRIPTION OF THE INVENTION

[0008] The space vector quantity of an electrical network the properties of whose negative sequence component can be determined by means of the method according to the invention may be, for example, voltage or current. Below, there is an example where the properties of the negative sequence component are determined for the voltage of an electrical network.

[0009] If no zero sequence component occurs in the electrical network, the total voltage is the sum of the negative sequence and the positive sequence components, in which case the graph of the voltage vector $\underline{u}_2$ in the network is an ellipse in accordance with Figure 1, and the voltage vector in question can be determined with the following equation:

$$\underline{u}_2 = u_{2,PSS} e^{j\omega t} + u_{2,NSS} e^{-j(\omega t - \phi)},$$

where $u_{2,PSS}$ is the magnitude of the positive sequence component of the voltage in the electrical network, $u_{2,NSS}$ is the magnitude of the negative sequence component of the voltage in the electrical network, ω is the angular frequency, t is time, and Φ is the phase-angle difference between the positive sequence and negative sequence systems at starting time. At the major semi-axis of the ellipse the angles of the positive and negative sequence system vectors are the same, so that the angle of the major semi-axis is

$$\alpha_{maj} = \phi / 2 + n\pi .$$

[0010] The length l_{maj} of the major semi-axis of the ellipse is the sum of the length $u_{2,PSS}$ of the positive sequence vector and the length $u_{2,NSS}$ of the negative sequence vector of the voltage. The minor semi-axis of the ellipse is perpendicular relative to the major semi-axis, so that its angle is

$$\alpha_{\min} = \phi / 2 - \pi / 2 + n\pi .$$

[0011] The length l_{min} of the minor semi-axis is the difference between the length $u_{2,PSS}$ of the positive sequence vector and the length $u_{2,NSS}$ of the negative sequence vector of the voltage. The length $u_{2,PSS}$ of the positive sequence vector of the voltage is received by dividing the sum of the length l_{maj} of the major semi-axis and the length l_{min} of the minor semi-axis by two.

$$u_{2,PSS} = \frac{l_{maj} + l_{\min}}{2}$$

[0012] Correspondingly, the length $u_{2,NSS}$ of the negative sequence vector of the voltage is received by dividing the difference between the length l_{maj} of the major semi-axis and the length l_{min} of the minor semi-axis by two.

$$u_{2,NSS} = \frac{l_{maj} - l_{\min}}{2}$$

[0013] On the basis of the above, the magnitudes of the positive sequence and negative sequence system components can be deduced from the lengths of the semi-axes of the ellipse. As noted above, the phase-angle difference between the positive sequence and negative sequence systems at starting time can be deduced from the angle of the major semi-axis of the ellipse. Thus, determining the negative sequence network can be returned to determining the properties of the sum voltage ellipse.

[0014] Figure 2 shows one way to determine components $u_{2\alpha,maj}$, $u_{2\beta,maj}$, $u_{2\alpha,min}$ and $u_{2\beta,min}$ of the major and minor semi-axes of the ellipse formed by the voltage space vector in the electrical network. The voltage vector components $u_{2\alpha}$ and $u_{2\beta}$ of the electrical network that have been measured first are low-pass-filtered in such a way that only a fundamental wave remains. The purpose of the low-pass filtering is to remove the harmonic components. The filter type is not restricted in any way, and the phase errors caused by the filters do not affect the functioning of the method.

[0015] In practice, there is no need to filter out the harmonic waves of the voltage vector components $u_{2\alpha}$ and $u_{2\beta}$ quite completely, but it suffices to reduce their number to a predetermined level. Thus, in some cases low-pass filtering may not be needed at all.

[0016] In the procedure shown in Figure 2, the axes of the ellipse are determined by recognizing the extreme value points of the length $|\underline{u}_{2f}|$ of

the fundamental wave voltage vector. The extreme value points are determined with a simple derivative test, which can be presented as a discreet algorithm below, where k is the time index and T_S is the sampling period.

1. Compute the length $|\underline{u}_{2f}|$ of the fundamental wave vector of the voltage.
2. Approximate the derivative with difference $d_k = (|\underline{u}_{2f}|_k - |\underline{u}_{2f}|_{k-1}) / T_s$.
3. Check the extreme value conditions.
   - If $d_k < 0$ and $d_{k-1} > 0$, a maximum (major semi-axis) is concerned.
   - If $d_k > 0$ and $d_{k-1} < 0$, a minimum (minor semi-axis) is concerned.
4. If a maximum or minimum was found, store the current $u_{2\alpha f,k}$ and $u_{2\beta f,k}$, depending on the type of the extreme value, as components of vector $\underline{u}_{2,maj}$ or $\underline{u}_{2,min}$.

[0017] The classification of the extreme values on the basis of the zeros of the derivative signal, taking place at point 3 in the algorithm, is analogous with the classification of extreme values of continuous functions based on the sign of the second derivative. In the practical implementation at point 1, the quadratic length of the fundamental wave vector can be used, because the square root as a monotonic function does not affect the extreme values. Further, at point 2 the difference quotient can be replaced with the difference by omitting the division by the sampling period T_S.

[0018] When the above-described algorithm is used, the sampling period T_S may be 100µs, for example. At point 4 of the algorithm, the number of values $u_{2\alpha f,k}$ and $u_{2\beta f,k}$ to be stored can, if desired, be halved by storing only the semi-axis components that are located at the left half-plane, for example.

[0019] Determination of the components of the semi-axes of the ellipse is the only time-critical stage in measuring the negative sequence system. The other stages may be implemented at slower time planes, for instance at a time plane of 1 ms. The lengths l_{maj} and l_{min} of the semi-axes of the voltage ellipse are computed by means of determined components with the following equations:

$$l_{maj} = \sqrt{u_{2\alpha,maj}^2 + u_{2\beta,maj}^2}$$ and

$$l_{min} = \sqrt{u_{2\alpha,min}^2 + u_{2\beta,min}^2}$$

[0020] The magnitudes $u_{2,PSS}$ and $u_{2,NSS}$ of the positive sequence and negative sequence components can be computed by means of the lengths l_{maj} and l_{min} of the semi-axes of the ellipse with the above-described equation. The following equation yields the angle α_{min} of the minor semi-axis of the ellipse:

$$\alpha_{min} = \arctan\left(\frac{u_{2\beta,min}}{u_{2\alpha,min}}\right).$$

[0021] One way to determine the length $u_{2,NSS}$ of the negative sequence vector of the voltage in the electrical network and the angle α_{min} of the minor semi-axis of the voltage ellipse is shown in Figure 3. The output information of the block diagram of Figure 2, i.e. the components of the major and minor semi-axes of the ellipse formed by the voltage space vector in the electrical network, is fed to the input of the block diagram of Figure 3.

[0022] Above, the ellipse formed by a voltage space vector in an electrical network is assumed to be of a shape of a complete ellipse, known from the theory of mathematics. In practice, the ellipse formed by a voltage space vector in an electrical network is always somewhat deformed, but it is obvious that this does not in any way prevent the use of the method according to the invention, because with an appropriate algorithm, the location of the semi-axes can be determined even from an incomplete ellipse. There are several known algorithms applicable to the determination of the semi-axes of incomplete ellipses, and the method according to the invention does not impose restrictions on the algorithm to be used.

[0023] In the above example, the method according to the invention is used for determining properties of a negative sequence component of the voltage in an electrical network. It will be obvious to a person skilled in the art that the method according to the invention can also be used for determining properties of a negative sequence component of other space vector quantities, such as current.

[0024] Above, the method according to the invention is used in a case where there is no zero sequence component in the electrical network. Although the presented method is based on measuring a space vector of a space vector quantity where a zero sequence component is not seen in any way, it is clear that the method according to the invention can be used for

determining also such space vector quantities in electrical networks where the zero sequence component occurs.

[0025] It will be obvious to a person skilled in the art that the basic idea of the invention can be implemented in a plurality of ways. Thus, the invention and its embodiments are not restricted to the above examples but may vary within the scope of the claims.

CLAIMS

1. A method for determining properties of a negative sequence component of a space vector quantity in an electrical network, **characterized** by comprising the steps of determining on the basis of the properties of an ellipse formed by a space vector of the space vector quantity in the electrical network the magnitude of the negative sequence component of the space vector quantity in the electrical network and the location of the negative sequence component of the space vector quantity in the electrical network in relation to a positive sequence component.

2. A method according to claim 1, **characterized** by the step of determining the location of the negative sequence component of the space vector quantity in the electrical network in relation to a positive sequence component comprising determining the angle (α_{min}) of the minor semi-axis of the ellipse formed by the space vector of the space vector quantity in the electrical network.

3. A method according to claim 1 or 2, **characterized** by comprising the steps of determining:

the components of the space vector of the space vector quantity in the electrical network;

the length of the space vector of the space vector quantity and its derivative;

the zeros of said derivative;

the components of the major and minor semi-axes of the ellipse formed by the space vector of the space vector quantity in the electrical network; and

the lengths (l_{maj}, l_{min}) of the major and minor semi-axes of the ellipse formed by the space vector of the space vector quantity.

4. A method according to claim 3, **characterized** by

determining several values for the length of the space vector of the space vector quantity, corresponding to several different moments of time, whereby the difference between two successive moments of time is equal to a sampling period (T_S);

the step for determining the derivative of the space vector of the space vector quantity comprising approximation of the derivative of the space vector of the space vector quantity with a difference (d_k) received by means of

the length values of the space vector of the space vector quantity and the sampling period (T_S) corresponding to successive moments of time;

the step for determining the components of the major and minor semi-axes formed by the space vector of the space vector quantity in the electrical network comprising steps where differences (d_{k-1}, d_k) representing the derivative of the space vector of the space vector quantity, corresponding to successive moments of time, are compared with zero, whereby, when the later one (d_k) of successive differences is smaller than zero and when the earlier difference (d_{k-1}) is greater than zero, a maximum is concerned, and when the later one (d_k) of successive differences is greater than zero and when the earlier difference (d_{k-1}) is smaller than zero, a minimum is concerned;

whereby, when a maximum is found, the current components of the space vector of the space vector quantity in the electrical network are set as components of the major semi-axis vector of the ellipse, and when a minimum is found, the current components of the space vector of the space vector quantity in the electrical network are set as components of the minor semi-axis vector of the ellipse.

5. A method according to claim 3 or 4, **c h a r a c t e r i z e d** by

determining the length (l_{maj}, l_{min}) of each semi-axis of the ellipse formed by the space vector of the space vector quantity by summing up the squared components of the semi-axis in question and by taking a square root of this sum;

determining the angle (α_{min}) of the minor semi-axis of the ellipse formed by the space vector of the space vector quantity trigonometrically on the basis of the components of the minor semi-axis of the ellipse in question; and that

determining the length of the negative sequence vector of the space vector quantity in the electrical network by dividing the difference of the lengths (l_{maj}, l_{min}) of the major and minor semi-axes of the ellipse formed by the space vector of the space vector quantity by two.

6. A method according to any one of claims 3 to 5, **c h a r a c t e r i z e d** by further comprising a step where by means of low-pass-filtering components of the space vector of the space vector quantity in the electrical network, the components containing substantially only a fundamental wave are provided, whereby the angle (α_{min}) of the minor semi-axis of the ellipse formed by the space vector of the space vector quantity and

the magnitude of the negative sequence component of the space vector quantity in the electrical network are determined on the basis of the space vector of the space vector quantity formed by said components containing substantially only a fundamental wave.

7. A method according to any one of the preceding claims, **characterized** by said space vector quantity in the electrical network being voltage (u_2).

Fig. 1

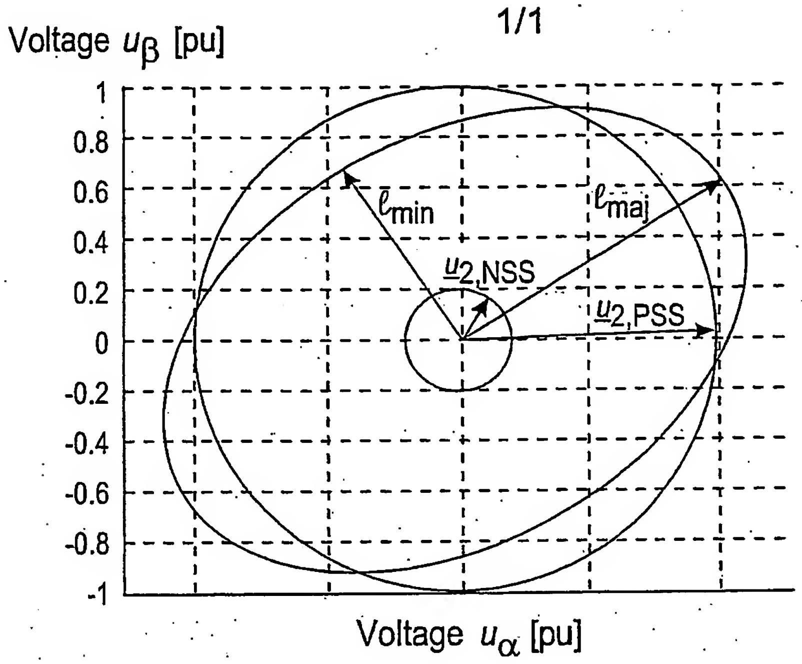


Fig. 2

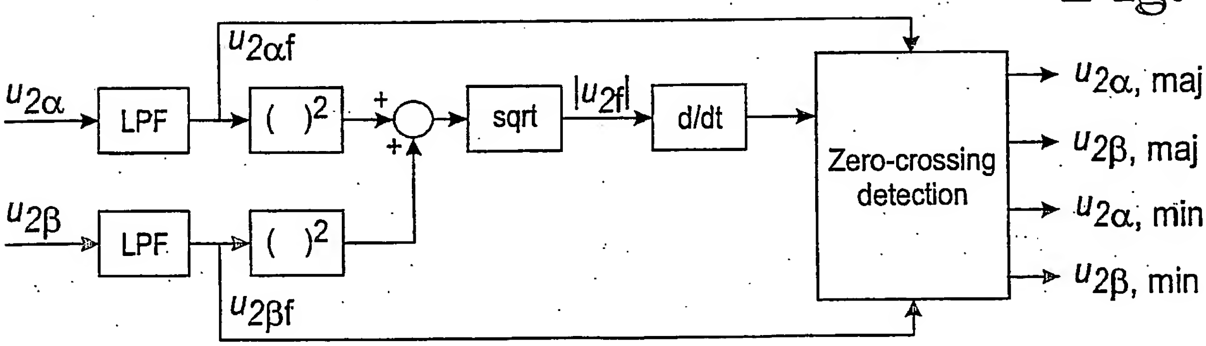
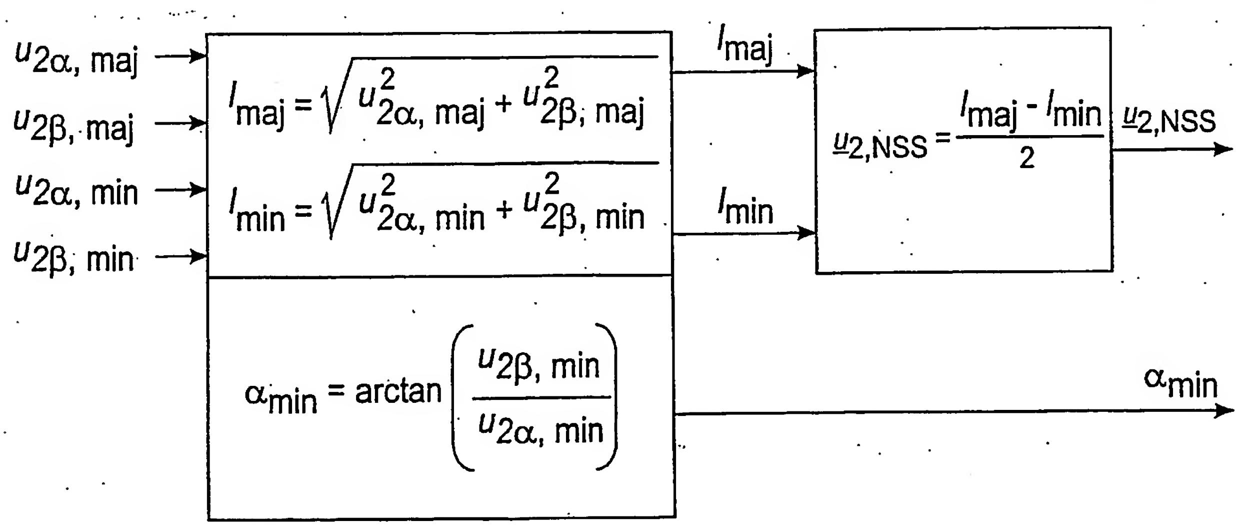


Fig. 3



INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 2004/000139

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G01R 29/16 // H02J 3/26
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: G01R, H02H, H02J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4210948 A (RICHARD W. WALTZ), 1 July 1980 (01.07.1980), column 1, line 20 - column 3, line 11 --	1-7
A	EP 0599648 A1 (ALLEN-BRADLEY COMPANY, INC.), 1 June 1994 (01.06.1994), page 5, line 6 - page 7, line 34 --	1-7
A	US 5426590 A (ERIC MARTIN), 20 June 1995 (20.06.1995), column 1, line 43 - line 61; column 4, line 31 - column 5, line 30 -- --------	1-7

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 May 2004	14 -06- 2004
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Irma Bornhede/MN Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT
Information on patent family members

30/04/2004

International application No.
PCT/FI 2004/000139

US	4210948 A	01/07/1980	CA	1123055 A	04/05/1982
EP	0599648 A1	01/06/1994	DE	69324107 D,T	09/09/1999
			US	5378979 A	03/01/1995
US	5426590 A	20/06/1995	DE	69305968 D	00/00/0000
			EP	0603088 A,B	22/06/1994
			FR	2699753 A,B	24/06/1994

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)
	)
Antti TARKIAINEN	) Group Art Unit: Not Yet Assigned
	)
Serial No.: Not Yet Assigned Finnish Appln. No. PCT/FI2004/000139	) Examiner: Not Yet Assigned
	)
	)
Filed: October 21, 2004	) Attorney Docket No. 66411-092
	)

For: METHOD FOR DETERMINING A NEGATIVE SEQUENCE COMPONENT

PRELIMINARY AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Concurrently with the filing of this application, please amend the application as follows:

Amendments to the Claims are reflected in the listing of claims which begin on page 2 of this paper.

Remarks begin on page 7 of this paper.

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Amendments to the Claims:

1. (Currently Amended) A method for determining properties of a negative sequence component of a space vector quantity in an electrical network, ~~characterized by comprising~~ wherein the method comprises the steps of determining on the basis of the properties of an ellipse formed by a space vector of the space vector quantity in the electrical network the magnitude of the negative sequence component of the space vector quantity in the electrical network and the location of the negative sequence component of the space vector quantity in the electrical network in relation to a positive sequence component.

2. (Currently Amended) A method according to claim 1, ~~characterized by~~ wherein the step of determining the location of the negative sequence component of the space vector quantity in the electrical network in relation to a positive sequence component comprises determining the angle ~~(α_{min})~~ of the minor semi-axis of the ellipse formed by the space vector of the space vector quantity in the electrical network.

3. (Currently Amended) A method according to claim 1~~-or 2~~, ~~characterized by comprising~~ wherein the method comprises the steps of determining:

the components of the space vector of the space vector quantity in the electrical network;

the length of the space vector of the space vector quantity and its derivative;

the zeros of said derivative;

the components of the major and minor semi-axes of the ellipse formed by the space vector of the space vector quantity in the electrical network; and

the lengths of the ~~(l_{maj}, l_{min})~~ of the major and minor semi-axes of the ellipse formed by the space vector of the space vector quantity.

4. (Currently Amended) A method according to claim 3, ~~characterized by~~ wherein

determining several values for the length of the space vector of the space vector quantity are determined, corresponding to several different moments of time, whereby the difference between two successive moments of time is equal to a sampling period ~~(T_s)~~;

the step for determining the derivative of the space vector of the space vector quantity comprising approximation of the derivative of the space vector of the space vector quantity with a difference ~~(d_k)~~ received by means of the length values of the space vector of the space vector quantity and the sampling period ~~(T_s)~~ corresponding to successive moments of time;

the step for determining the components of the major and minor semi-axes formed by the space vector of the space vector quantity in the electrical network comprising steps where differences ~~(d_{k-1}, d_k)~~ representing the derivative of the space vector of the space vector quantity, corresponding to successive moments of time, are compared with zero, whereby, when the later one ~~(d_k)~~ of successive differences is smaller than zero and when the earlier difference ~~(d_{k-1})~~ is greater than zero, a maximum is concerned, and when the later one ~~(d_k)~~ of successive differences is greater than zero and when the earlier difference ~~(d_{k-1})~~ is smaller than zero, a minimum is concerned;

whereby, when a maximum is found, the current components of the space vector of the space vector quantity in the electrical network are set as components of the major semi-axis vector of the ellipse, and when a minimum is found, the current components of the space vector of the space vector quantity in the electrical network are set as components of the minor semi-axis vector of the ellipse.

5. (Currently Amended) A method according to claim 3 ~~or 4~~, ~~characterized by~~ wherein

~~determining~~ the length ~~(l_{maj}, l_{min})~~ of each semi-axis of the ellipse formed by the space vector of the space vector quantity is determined by summing up the squared components of the semi-axis in question and by taking a square root of this sum;

~~determining~~ the angle ~~(α_{min})~~ of the minor semi-axis of the ellipse formed by the space vector of the space vector quantity is determined trigonometrically on the basis of the components of the minor semi-axis of the ellipse in question; and ~~that~~

~~determining~~ the length of the negative sequence vector of the space vector quantity in the electrical network is determined by dividing the difference of the lengths ~~(l_{maj}, l_{min})~~ of the major and minor semi-axes of the ellipse formed by the space vector of the space vector quantity by two.

6. (Currently Amended) A method according to ~~any one of claims 3 to 5~~ claim 3, ~~characterized by further comprising~~ w h e r e i n the method further comprises a step where by means of low-pass-filtering components of the space vector of the space vector quantity in the electrical network, the components containing substantially only a fundamental wave are provided, whereby the angle of ~~(α_{min})~~ the minor semi-axis of the ellipse formed by the space vector of the space vector quantity and the magnitude of the negative sequence component of the space vector quantity in the electrical network are determined on the basis of the space vector of the space vector quantity formed by said components containing substantially only a fundamental wave.

7. (Currently Amended) A method according to ~~any one of the preceding claims, characterized by~~ claim 1, w h e r e i n said space vector quantity in the electrical network being ~~is~~ voltage ~~(u_2)~~.

Please add the following new claims:

8. (New) A method according to claim 2, w h e r e i n the method c o m p r i s e s the steps of determining:

the components of the space vector of the space vector quantity in the electrical network;

the length of the space vector of the space vector quantity and its derivative;

the zeros of said derivative;

the components of the major and minor semi-axes of the ellipse formed by the space vector of the space vector quantity in the electrical network; and

the lengths of the major and minor semi-axes of the ellipse formed by the space vector of the space vector quantity.

9. (New) A method according to claim 8, w h e r e i n

several values for the length of the space vector of the space vector quantity are determined, corresponding to several different moments of time, whereby the difference between two successive moments of time is equal to a sampling period;

the step for determining the derivative of the space vector of the space vector quantity comprising approximation of the derivative of the space vector of the space vector quantity with a difference received by means of the length values of the space vector of the space vector quantity and the sampling period corresponding to successive moments of time;

the step for determining the components of the major and minor semi-axes formed by the space vector of the space vector quantity in the electrical network comprising steps where differences representing the derivative of the space vector of the space vector quantity, corresponding to successive moments of time, are compared with zero, whereby, when the later one of successive differences is smaller than zero and when the earlier difference is greater than zero, a maximum is concerned, and when the later one of successive differences is greater than zero and when the earlier difference is smaller than zero, a minimum is concerned;

whereby, when a maximum is found, the current components of the space vector of the space vector quantity in the electrical network are set as components of the major semi-axis vector of the ellipse, and when a minimum is found, the current components of the space vector of the space vector quantity in the electrical network are set as components of the minor semi-axis vector of the ellipse.

10. (New) A method according to claim 4, w h e r e i n

the length of each semi-axis of the ellipse formed by the space vector of the space vector quantity is determined by summing up the squared components of the semi-axis in question and by taking a square root of this sum;

the angle of the minor semi-axis of the ellipse formed by the space vector of the space vector quantity is determined trigonometrically on the basis of the components of the minor semi-axis of the ellipse in question; and

the length of the negative sequence vector of the space vector quantity in the electrical network is determined by dividing the difference of the lengths of the major and minor semi-axes of the ellipse formed by the space vector of the space vector quantity by two.

11. (New) A method according to claim 4, w h e r e i n the method further comprises a step where by means of low-pass-filtering components of the space vector of the space vector quantity in the electrical network, the components containing substantially only a fundamental wave are provided, whereby the angle of the minor semi-axis of the ellipse formed by the space vector of the space vector quantity and the magnitude of the negative sequence component of the space vector quantity in the electrical network are determined on the basis of the space vector of the space vector quantity formed by said components containing substantially only a fundamental wave.

12. (New) A method according to claim 5, w h e r e i n the method further comprises a step where by means of low-pass-filtering components of the space vector of the space vector quantity in the electrical network, the components containing substantially only a fundamental wave are provided, whereby the angle of the minor semi-axis of the ellipse formed by the space vector of the space vector quantity and the magnitude of the negative sequence component of the space vector quantity in the electrical network are determined on the basis of the space vector of the space vector quantity formed by said components containing substantially only a fundamental wave.

REMARKS

This Amendment is for the purpose of deleting multiple dependent claims; to correct any informalities; and to add claims 8 –12.

Allowance of the claims is earnestly solicited.

Respectfully submitted,
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Application Number	UNASSIGNED
Filing Date	October 21 ,2004
First Named Inventor	Antti TARKIAINEN
Art Unit	UNASSIGNED
Examiner Name	UNASSIGNED
Attorney Docket Number	066411-092

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Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

☒ Attorney or Agent of record. Registration Number 25,505

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Typed or Printed Name	John P. DeLuca		
Signature			
Date	October 20, 2004	Telephone	(202) 906-8600

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

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10/512,054	10/21/2004	Antti Tarkiainen	66411-092	8413

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HOFF, MARC S	
ART UNIT	**PAPER NUMBER**
2857	

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Please find below and/or attached an Office communication concerning this application or proceeding.

DUE 10/15/06
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ENTERED BY ASB ON 9/18/06

PTO-90C (Rev. 10/03)

Notice of Non-Compliant Amendment (37 CFR 1.121)	Application No. 10512054	Applicant(s)
	Examiner	Art Unit

– The MAILING DATE of this communication appears on the cover sheet with the correspondence address –

The amendment document filed on 10-21-04 is considered non-compliant because it has failed to meet the requirements of 37 CFR 1.121 or 1.4. In order for the amendment document to be compliant, correction of the following item(s) is required.

THE FOLLOWING MARKED (X) ITEM(S) CAUSE THE AMENDMENT DOCUMENT TO BE NON-COMPLIANT:

☐ 1. Amendments to the specification:
- ☐ A. Amended paragraph(s) do not include markings.
- ☐ B. New paragraph(s) should not be underlined.
- ☐ C. Other _____.

☐ 2. Abstract:
- ☐ A. Not presented on a separate sheet. 37 CFR 1.72.
- ☐ B. Other _____.

☐ 3. Amendments to the drawings:
- ☐ A. The drawings are not properly identified in the top margin as "Replacement Sheet," "New Sheet," or "Annotated Sheet" as required by 37 CFR 1.121(d).
- ☐ B. The practice of submitting proposed drawing correction has been eliminated. Replacement drawings showing amended figures, without markings, in compliance with 37 CFR 1.84 are required.
- ☐ C. Other _____.

☑ 4. Amendments to the claims:
- ☐ A. A complete listing of all of the claims is not present.
- ☐ B. The listing of claims does not include the text of all pending claims (including withdrawn claims)
- ☑ C. Each claim has not been provided with the proper status identifier, and as such, the individual status of each claim cannot be identified. Note: the status of every claim must be indicated after its claim number by using one of the following status identifiers: (Original), (Currently amended), (Canceled), (Previously presented), (New), (Not entered), (Withdrawn) and (Withdrawn-currently amended).
- ☐ D. The claims of this amendment paper have not been presented in ascending numerical order.
- ☑ E. Other: 12 original claims, amendment adds claims 8-12

☐ 5. Other (e.g., the amendment is unsigned or not signed in accordance with 37 CFR 1.4): _____

For further explanation of the amendment format required by 37 CFR 1.121, see MPEP § 714.

TIME PERIODS FOR FILING A REPLY TO THIS NOTICE:

1. Applicant is given **no new time period** if the non-compliant amendment is an after-final amendment, an amendment filed after allowance, or a drawing submission (only). If applicant wishes to resubmit the non-compliant after-final amendment with corrections, the **entire corrected amendment** must be resubmitted.

2. Applicant is given **one month**, or thirty (30) days, whichever is longer, from the mail date of this notice to supply the correction, if the non-compliant amendment is one of the following: a preliminary amendment, a non-final amendment (including a submission for a request for continued examination (RCE) under 37 CFR 1.114), a supplemental amendment filed within a suspension period under 37 CFR 1.103(a) or (c), and an amendment filed in response to a *Quayle* action. If any of above boxes 1. to 4. are checked, the correction required is only the **corrected section** of the non-compliant amendment in compliance with 37 CFR 1.121.

Extensions of time are available under 37 CFR 1.136(a) only if the non-compliant amendment is a non-final amendment or an amendment filed in response to a *Quayle* action.

Failure to timely respond to this notice will result in:
- **Abandonment** of the application if the non-compliant amendment is a non-final amendment or an amendment filed in response to a *Quayle* action; or
- **Non-entry** of the amendment if the non-compliant amendment is a preliminary amendment or supplemental amendment.

Eva Gillis
Legal Instruments Examiner (LIE), if applicable

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